Section 2

The Science of Climate Change – Global and Regional Application

To incorporate climate change into water resources planning, it is important to understand what it is, how it happens, and how to quantify it in the future. In the media and in society the terms "climate change" and "global warming" are often misused, and it is easy to mistakenly use projected changes in climate for other analyses.

This section focuses on:

- Our current scientific understanding of mechanisms for climate change;
- Current observations of climate change in California;
- Our best estimates of how the climate may change in the future;
- Potential impacts that the warming climate will have, and in some cases is already having, on water resources; and
- Modeling methods used by the scientific community to develop climate change projections.

2.1 Climate Change and Global Warming

In the most general sense, climate change is the long-term change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It is well-documented and widely accepted that the Earth's climate has fluctuated and changed throughout history. Global warming is the name given to the increase in the average temperature of the Earth's near-surface air and oceans that has been observed since the mid-20th century and is projected to continue. Warming of the climate system is now considered to be unequivocal (IPCC 2007a). Global warming, therefore, refers to a specific type of rapid climate change occurring over the last 60 years and projected to continue into the future which falls outside of the normal range of historic climate variation.

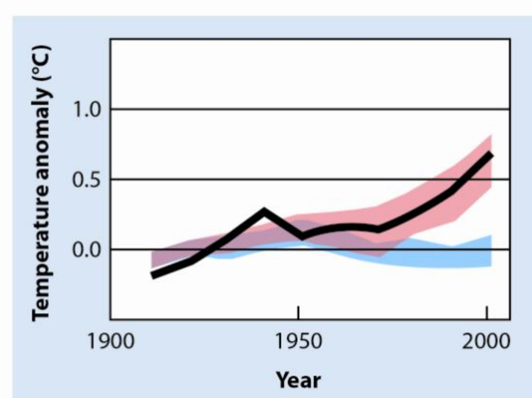

Figure 2-1: Observed and Simulated Global Temperature Trend over the Twentieth Century. The black line is observed data; blue is model results incorporating natural forcings only; and pink is model results incorporating anthropogenic GHG emissions. (Source: IPCC 2007a)

Throughout this handbook the term "climate change" is used to describe general projected changes in the Earth's climate, including those resulting from global warming.

2.1.1 Greenhouse Gases and Climate Change

There has been considerable political debate surrounding the causes of climate change; however, there is near unanimous consensus within the scientific community that observed warming trends are a result of increased GHG concentrations in the atmosphere (IPCC 2007a). According to the IPCC, "Most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations" (IPCC 2007b).

Understanding the basic mechanisms influencing the global warming process illustrates both the importance of reducing GHG emissions to mitigate further climate change as much as possible, and the need to adapt to future climate conditions. Understanding how future climate projections are developed also helps planners understand and incorporate the inherent uncertainties in future climate change projections.

This handbook does not provide in-depth discussion of current climate observations or the mechanisms behind climate change. Good sources for further information include:

1. Pew Center on Global Climate Change and Pew Center on the States. "Climate Change 101: Science and Impacts": http://www.pewclimate.org/docUploads/101_Science_Impacts.pdf

2. U. S. Global Change Research Program/Climate Change Science Program. "Climate Literacy: the Essential Principles of Climate Sciences": http://climate.noaa.gov/index.jsp?pg=/education/edu_index.jsp&edu=literacy

3. UNSW Climate Change Research Centre. "The Copenhagen Diagnosis": http://www.ccrc.unsw.edu.au/Copenhagen/Copenhagen_Diagnosis_HIGH.pdf

4. U. S. Global Change Research Program/Climate Change Science Program brochure. "Climate Literacy: the Essential Principles of Climate Sciences": http://www.globalchange.gov/what-we-do/assessment/previous-assessments/global-climate-change-impacts-in-the-us-2009

Additional sources that provide more detail than discussed in this handbook are included in the literature review presented in Appendix A.

2.1.2 The Greenhouse Effect

Certain gases in the atmosphere, including carbon dioxide, methane, and water vapor, play a natural role in keeping the Earth's atmosphere warm. When the sun's energy enters the atmosphere, much of it reflects off the land and ocean surfaces. GHGs trap some of the heat, keeping it from exiting the atmosphere. This keeps the earth's temperature fairly constant in the long-term. This process is depicted in Figure 2-2.

The principal gases associated with anthropogenic atmospheric warming are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbon (PFC), nitrogen trifluoride (NF_3), and hydrofluorocarbon (HFC) (California State law (Health & Safety Code, §38505, subd.(g); California Environmental Quality Act (CEQA) Guidelines, §15364.5)). Water vapor is also an important GHG, in that it is responsible for trapping more heat than any of the other GHGs. However, water vapor is not a GHG of concern with respect to anthropogenic activities and emissions because human activities have a relatively small impact on water vapor concentration in the atmosphere. Each of the principal GHGs associated with anthropogenic climate warming has a long atmospheric lifetime (one year to several thousand years). In addition, the potential heat-trapping ability, or global warming potential, of each of these gases varies significantly from one another. For instance, CH_4 is 23 times more potent than CO_2, while SF_6 is 22,200 times more potent than CO_2 (IPCC 2001). Conventionally, GHGs have been reported as "carbon dioxide equivalents" (CO_2e)that take into account the relative potency of non-CO_2 GHGs and convert their quantities to an equivalent amount of CO_2 so that all emissions can be reported as a single quantity.

The Greenhouse Effect

Illustration of the greenhouse effect (adapted with permission from the Marian Koshland Science Museum of The National Academy of Sciences). Visible sunlight passes through the atmosphere without being absorbed. Some of the sunlight striking the earth ❶ is absorbed and converted to heat, which warms the surface. The surface ❷ emits heat to the atmosphere, where some of it ❸ is absorbed by greenhouse gases and ❹ re-emitted toward the surface; some of the heat is not trapped by greenhouse gases and ❺ escapes into space. Human activities that emit additional greenhouse gases to the atmosphere ❻ increase the amount of heat that gets absorbed before escaping to space, thus enhancing the greenhouse effect and amplifying the warming of the earth.

Figure 2-2: The Greenhouse Effect (Pew Center on Global Climate Change 2011).

When the greenhouse gas concentration in the atmosphere increases, so does the atmosphere's capability to retain heat. Large increases in the concentration of atmospheric carbon dioxide decrease the amount of solar radiation reflected back into space. As a result, more radiation is retained as heat. Over an extended period of time, this change in Earth's energy balance increases global average temperatures. Over the past century, an increase of 1.5 degrees Fahrenheit (degrees F) was observed, with most of the warming occurring in the last 30 years. In addition to a general warming trend in most places, temperature changes have already started to impact ice and snow presence, atmospheric and oceanic circulation patterns, and weather event severity (IPCC 2007a).

2.2 Climate Models

Long-term observational data are showing trends in temperature, sea levels, precipitation, and many other environmental variables. However, using historical observations to project future trends may not accurately represent these environmental changes. Use of computer models based on our understanding of global atmospheric and ocean thermodynamics has become a widely accepted method for estimating future climate change. The IPCC reviews development of several general circulation models (GCMs) that express the international community's best scientific understanding of the Earth's atmosphere and oceans over time (IPCC 2011). These complex computational models are able to simulate climate processes and provide projections of climate variables, such as temperature and precipitation, at monthly time intervals. The model results can be processed for use in other analyses. This section provides an overview of the GCM results developed through the IPCC, and ways in which these model results are being made accessible to planners in California.

2.2.1 Intergovernmental Panel on Climate Change

The IPCC is an international scientific body comprised of thousands of contributing scientists from around the world and is tasked with synthesizing climate literature for decision makers. The IPCC Assessment Reports include discussions of climate projections generated from several GCMs. Results from GCMs are varied, not only because there are several different models that represent the climate differently and solve physical circulation and chemical equations differently, but also because there is uncertainty about future GHG emissions levels will be. Future GHG emissions are dependent on future population growth, economic development, and advances in technology (e.g., energy use). The IPCC Special Report on Emissions Scenarios (SRES) has established emissions scenarios as standards for comparisons of modeling projections across a reasonable range of possible future conditions (IPCC 2000). These emissions scenarios represent various potential future scenarios of per capita energy use, economic growth, and population growth. These scenarios are:

- A1: The A1 emissions scenarios represent a future with both rapid economic growth and rapid transition to more efficient technologies. These scenarios represent a global population that peaks in mid-century. The A1 scenario is divided into three groups that describe alternative directions of technological change:
  - A1FI represents fossil fuel-intensive energy consumption,
  - A1T represents use of non-fossil energy resources, and
  - A1B represents a balance of energy sources.
- B1: This scenario represents a more environmentally friendly future, with the same global population as A1, but with more rapid changes in economic structures toward a service and information economy.

- A2: This scenario represents emissions in a very heterogeneous future with high population growth, slower and more fragmented economic development, and technological change.
- B2: This scenario represents emissions in a future with intermediate population and economic growth, emphasizing local solutions to economic, social, and environmental sustainability.

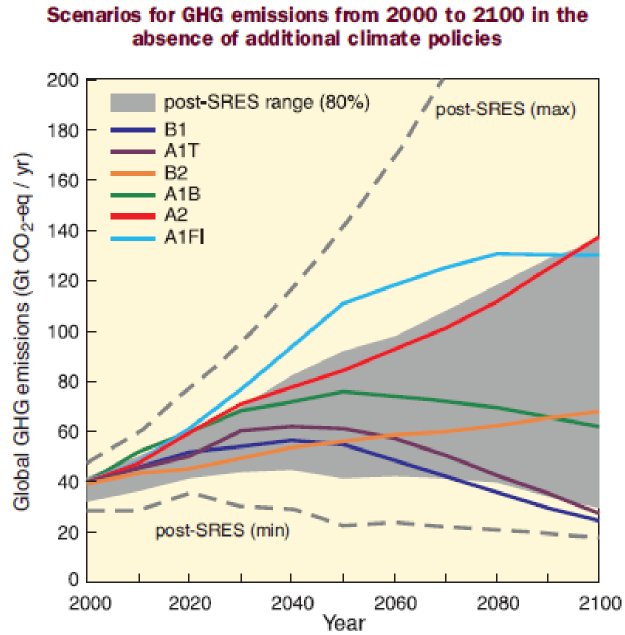

Figure 2-3: SRES Emissions Scenarios. (Source: IPCC 2007b)

The emissions associated with each scenario are depicted in Figure 2-3. More information on the models and emissions scenarios can be found in the IPCC 4th Assessment Synthesis Report (IPCC 2007a), and online via the IPCC Data Distribution Center (http://www.ipcc-data.org/index.html). The Fifth IPCC Assessment Report will be completed in 2013/2014, and will reflect climate projections using a new set of emissions scenarios (IPCC 2010). It is important to use the most current data and climate projections for IRWMPs. The concepts and methods presented in this handbook can be applied to any set of simulations. The new data and simulations will not change the general framework presented in the handbook. Uncertainties associated with climate projections are discussed in Box 2-1.

2.2.2 Regional Climate Analysis

The GCM projections provide estimates of future climate on a global scale, but do not provide data on a scale useful for local planning. Analyses on the scale of a watershed, for example, require input of precipitation and other climate data of a more refined spatial resolution. GCM model results must be downscaled to local scales in order to aid in planning-level analyses. There are several ways to downscale GCM model results to finer resolution, including use of statistical models and dynamic regional models.

While there are several approaches to downscaling GCM data for local analysis, a comprehensive set of model projections from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project Phase 3 (CMIP3) multi-model dataset is widely used (US Bureau of Reclamation (BOR) 2011a , Cox et al 2011, e.g.). The CMIP3 archive can be retrieved from: http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/, and is described by Maurer et al. (2007). The CMIP3 archive is downscaled using bias-corrected spatial downscaling (BCSD). This dataset contains 16 different GCM models run with three different emissions scenarios (A1B, A2, and B1) resulting in a total of 112 climate projections spanning the years 1950-2099.

Uncertainties in Climate Projections

The scientific community is continually updating the GCMs to make them as accurate as possible. However, there are many sources of uncertainty inherent in projections of future climate variables, and these uncertainties add an additional layer of complexity to planning. There is uncertainty associated with (IPCC 2007):

- *The emissions scenarios*. The scenarios supported by the IPCC are their best representation of potential futures, and encompass "best" and "worst" cases as well as they can estimate them. However, there is significant uncertainty associated with future global GHG emissions.
- *Data limitations*. The historical dataset available for calibrating GCMs is spatially biased towards developed nations. In addition, difficulties associated with monitoring extreme events make model-data comparisons difficult.
- *Scientific Understanding*. The models represent current understanding of the Earth's physical response to increased GHG emissions. There are still many open questions regarding how the Earth responds to a warming climate. For example, uncertainties associated with ice flows in Antarctica and Greenland impact GCM results. The relative strength of various global feedback loops is also unclear.

There are many other sources of uncertainty associated with the climate models. The IPCC Fourth Assessment Report (IPCC 2007a) provides a discussion of these and other uncertainties, and also discusses more robust outcomes of the models (some of which are included in this section of the handbook). Ways of quantifying uncertainty and incorporating it into the planning process are discussed in Appendix B and Section 7, respectively.

Box 2-1

BCSD has been widely used in studies analyzing climate change impacts on water resources throughout California. A comparison of stream flows estimated in the Sacramento and San Joaquin Valleys using climate projections downscaled with BCSD and Constructed Analogue (CA), another downscaling technique, shows that BCSD data more accurately estimates stream flows than CA (Chung et al 2009). Some benefits to using BCSD-data include (BOR 2011a):

- BCSD is well documented for applications in the United States.
- The BCSD method is efficient, allowing the CMIP3 archive to develop downscaled projections from several models and emissions scenarios. This makes it possible to capture uncertainties in GCM projections.
- Projections downscaled using BCSD are often able to statistically reflect observed regional characteristics.

- The BCSD methodology results in a spatially continuous set of precipitation and temperature data that is appropriate for watershed and other smaller-scale analyses.

While there are many advantages to using BCSD-downscaled GCM projections for local planning, there are also limitations. An underlying assumption inherent in BCSD downscaling is that the relationship between large-scale phenomena modeled by the GCMs and smaller-scale, local phenomena will remain the same in the future as it has been in the past. Bias correction methods in BCSD assume that GCM biases observed on historical-modeled data comparisons will also be present in model results representing future conditions. These and other limitations of the CMIP3 archive are discussed at http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/#Limitations. Other downscaling methods may be better for some types of analysis. Maurer and Hidalgo (2008) conclude that the CA downscaling method is generally better than BCSD for capturing fall and winter low-temperature extremes and summer high-temperature extremes (Mastrandrea et al. 2009).

2.3 Observed and Modeled Climate Trends

The GCMs provide our best estimate of climate in the future, but many climate impacts are already being observed in California and around the world. Current observations are useful for localized climate information and also for fine-tuning GCMs. This section discusses some observations that highlight the importance of data monitoring such as that conducted on a regional scale as part of an IRWMP.

2.3.1 Current Observed Climate Trends in California

Evidence of climate change is already being observed in California. In the last century, the California coast has seen a sea level rise of seven inches (DWR 2008). The average April 1 snow-pack in the Sierra Nevada region has decreased in the last half century (Howat and Tulaczyk 2005, CCSP 2008), and wildfires are becoming more frequent, longer, and more wide-spread (Sierra Nevada Alliance (SNA) 2010, CCSP 2008).

While California's average temperatures have increased by 1 degree F in the last hundred years, trends are not uniform across the state. The Central Valley has actually been experiencing a slight cooling trend in the summer, likely due to an increase in irrigation (California Energy Commission (CEC) 2008). Higher elevations have experienced the highest temperature increases (DWR 2008). Many of the state's rivers have seen increases in peak flows in the last 50 years (DWR 2008).

While historical trends in precipitation do not show a statistically significant change in average precipitation over the last century (DWR 2006), regional precipitation data show a trend of increasing annual precipitation in northern California (DWR 2006) and decreasing annual precipitation throughout Southern California over the last 30 years (DWR 2008).

2.3.2 Anticipated Future Climate Trends in California

Climate change has a complex impact on various climate variables. Mean temperatures are expected to shift in response to GHGs in the atmosphere. In addition, the distribution of various climate variables may change. These shifts in distribution are harder to quantify, but are potentially important, as they influence the frequency of extreme events, such as heat waves and droughts. Figure 2-4 depicts some of the ways that climate can change in the future for temperature and precipitation.

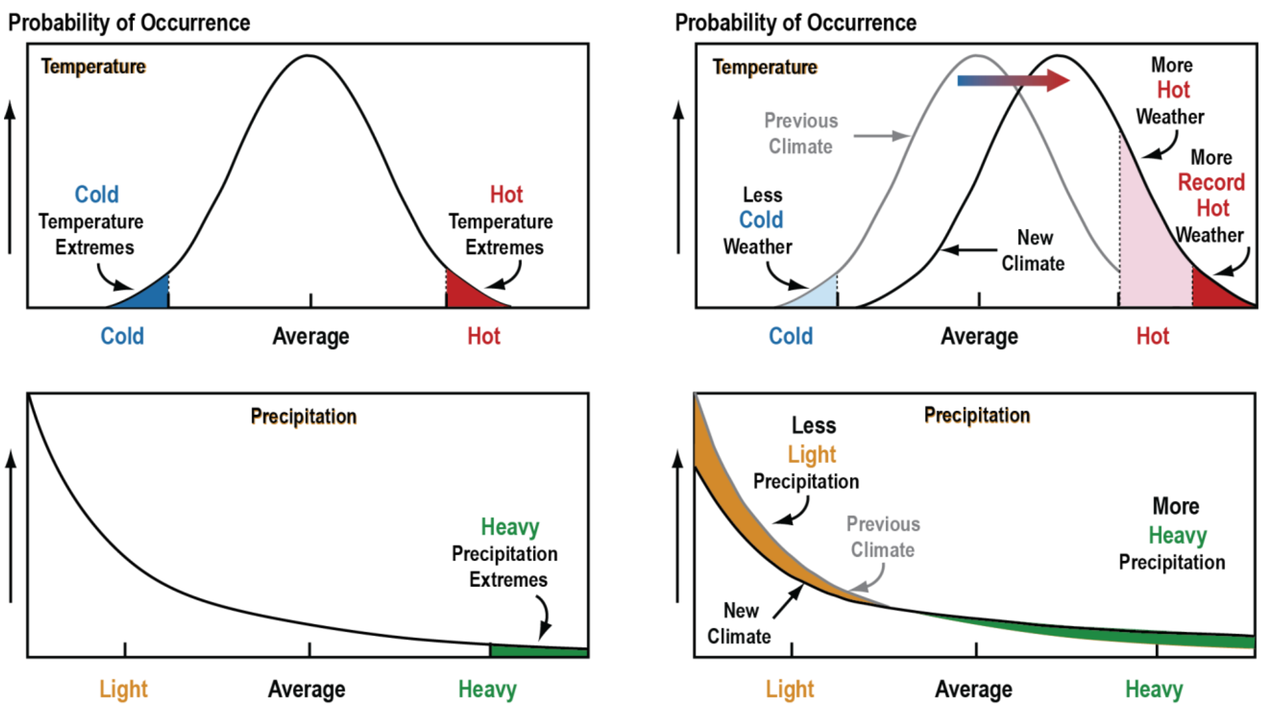

Figure 2-4: Graphical description of extreme events and potential event probability distributions related to climate variables (Source: CCSP 2008).

2.3.2.1 Projected Climate Changes

Models project that in the first 30 years of the 21st Century, overall summertime temperatures in California will increase by 0.9 to 3.6 degrees F (CAT 2009). Average temperatures in California are expected to increase by 3.6 to 10.8 degrees F by the end of this century (Cayan et al 2006). This large divergence in temperature for longer time horizons is a result of uncertainty in future GHG emissions. If future global emissions continue to increase, temperatures are more likely to increase at a faster pace (CAT 2009). This aspect of climate projection is discussed further in Section 2.2.1. As an example, temperature increases in Pasadena over the next century are shown in Figure 2-5.

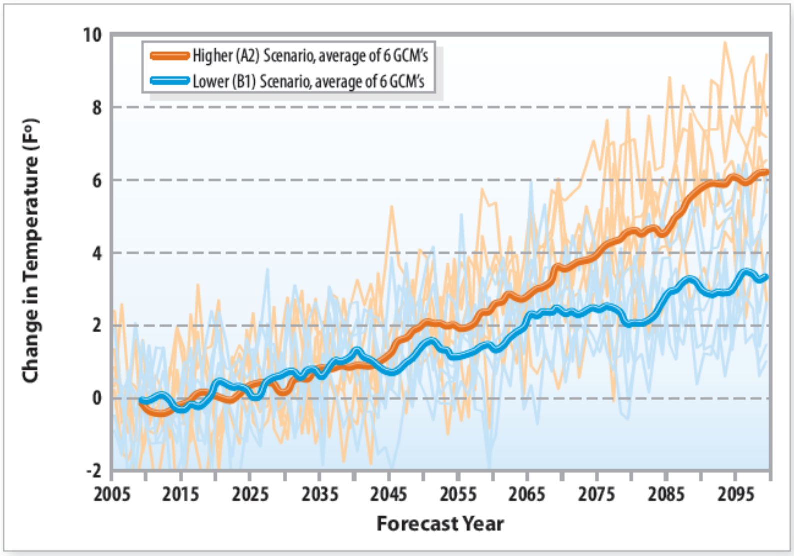

Figure 2-5: Projected Temperatures Resulting from 6 GCMs and 2 emissions scenarios. Lighter lines are individual GCM results, darker lines are average A2 and B1 projections. Models used include CNRM CM3, GFDL CM2.1, Miroc3.2 (medium resolution), MPI ECHAM5, NCAR CCSM3, NCAR PCM1. (Source: Pasadena Water and Power 2011)

Increases in temperature are not likely to be felt uniformly everywhere. Model projections generally agree that warming will be greater in California in the summer than in the winter (CAT 2009) and inland areas are likely to experience more extreme warming than coastal areas (California Natural Resources Agency (CNRA) 2009). These non-uniform warming trends are one of the reasons that regional approaches to addressing climate change are important.

While projections of temperature show high levels of agreement across various models and emissions scenarios, projected changes in precipitation are more varied. Taken as an ensemble, downscaled GCM results show little, if any, change in average precipitation for California before 2050 (DWR 2006), with a drying trend emerging after 2050 (BOR 2011a, CCSP 2009). While little change in precipitation is projected by the ensemble average of several GCMs, individual GCM results are considerably varied. Climate projections therefore imply an increase in the uncertainty of future precipitation conditions.

2.3.2.2 Extreme Weather Events

As the climate warms, extreme events are expected to become more frequent, including wildfires, floods, droughts, and heat waves.

In contrast, freezing spells are expected to decrease in frequency over most of California (Mastrandrea 2009). While GCM projections may indicate little, if any, change in average precipitation moving into the future, extreme precipitation events are expected to become more common-place (Congressional Budget Office (CBO) 2009). Atmospheric rivers, sometimes also called "pineapple express storms," have historically been responsible for creating the heaviest storms in California. These storms are characterized by long, thin bands of air with a high water vapor content that occasionally stretch over California from the Pacific Ocean. Years with several atmospheric river events could become more frequent over the next century (Dettinger 2011).

In addition to pineapple express storms, droughts and heat waves are also expected to become more frequent, longer, and more spatially extensive (CNRA 2009). The combination of drier and warmer weather compounds expected impacts on water supplies and ecosystems in the Southwestern US (CCSP 2009). Wildfires are also expected to continue to increase in frequency and severity (CCSP 2009, SNA 2010).

2.4 Current and Future Impacts on Water Resources

Water resources in California and across the US are already being impacted by climate change. The impacts will affect water supplies, water quality, flood management, hydropower production, water demands, ecosystems, and coastal areas, often in unexpected ways. For example, increased temperatures can exacerbate dissolved oxygen (DO) deficiencies in water bodies. Temperature increases are already causing more precipitation to fall as rain than as snow, which has impacts on snowpack storage for water supplies. As droughts become more common, water demands for irrigation uses will increase.

Climate change also introduces an added level of uncertainty to water resources. Future climate projections are far from certain, and variables like precipitation show large disagreement among GCMs. Impacts to water resources are summarized below. More details on these impacts are also discussed in Section 4, and ways of assessing and planning for their associated uncertainties are discussed in Sections 5 and 7, and Appendix B.

Water Supply. Increased temperatures will result in more winter precipitation in the mountains falling as rain rather than snow. DWR anticipates a 20 to 40 percent decrease in the state's snowpack water storage by the year 2050 (DWR 2008). This snowpack reduction impacts large water systems such as the State Water Project (SWP), the Central Valley Project (CVP), and water systems that rely on the Colorado River. It also impacts smaller watersheds relying on snowpack for water supply. Shifts in run-off timing have already been observed: the fraction of total annual runoff occurring between April and July has decreased by 23 percent in the Sacramento Basin and by 19 percent in the San Joaquin Basin (CEC 2008).

The 2009 SWP/CVP impacts report (Chung et al 2009) evaluates climate change impacts on both the SWP and CVP supply projects. The results from this report are the basis for taking climate change into account in the SWP 2009 Delivery Reliability Report (DWR 2010b). Using the BCSD downscaling method, climate change projections were applied to hydrologic and hydraulic models to develop flows into the Sacramento-San Joaquin Delta (Delta). This study indicates that Delta exports may be reduced by up to 25% by the end of the century, under certain emissions scenarios. Figure 2-6 shows Delta exports at the end of the century projected with and without climate change, as well as the frequency at which total Delta exports are likely to exceed various flows.

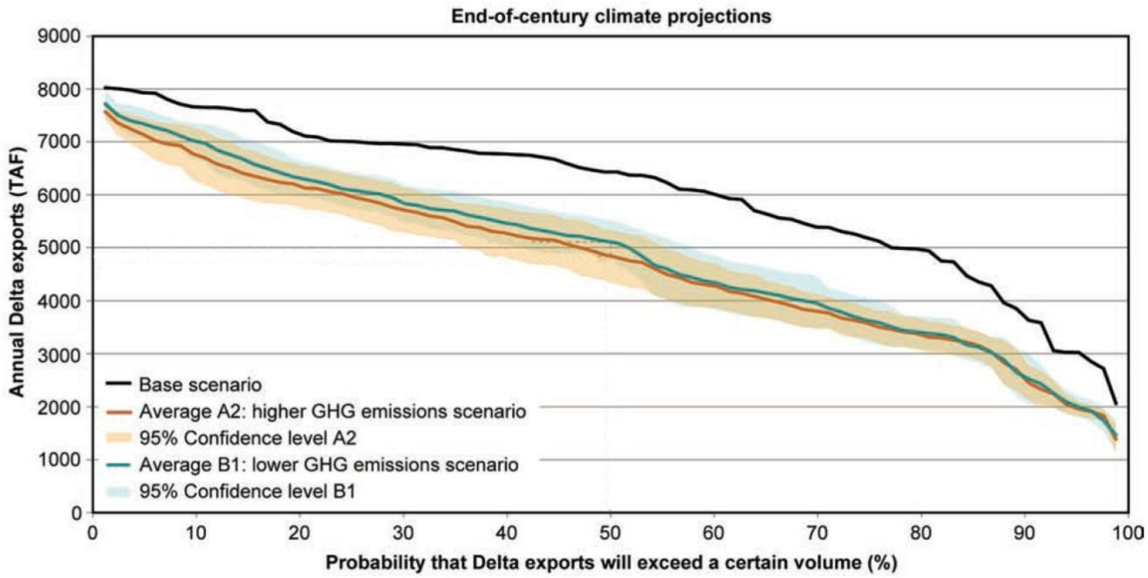

Figure 2-6: End-of-century projected Delta exports using various emissions scenarios. (Source: Chung et al 2009)

In addition to the timing of stream flows, climate change may also alter the total amounts of runoff in watersheds. While precipitation projections do not show a clear trend in the future, an ensemble of twelve climate models shows a trend of decreasing runoff for Southern California between the end of the twentieth and twenty first centuries (IPCC 2008).

Water Demand. The seasonal component of water demands (e.g., landscape irrigation and water used for cooling processes) will likely increase with climate change as droughts become more common and more severe, temperatures alter evapotranspiration rates, and growing seasons become longer. Without accounting for changes in evapotranspiration rates, agricultural crop and urban outdoor demands are expected to increase in the Sacramento Valley by as much as 6% (Chung et al 2009).

Water Quality. Water quality can be impacted by both extreme increases and decreases in precipitation. Increases in storm event severity may result in increased turbidity in surface water supplies (DWR 2008). Lowered summertime precipitation may also leave contaminants more concentrated in streamflows. Higher water temperatures may exacerbate reservoir water quality issues associated with dissolved oxygen levels; and increased algal blooms (DWR 2008). Salt intrusion may also impact coastal water supplies like the Delta (Chung et al 2009) and coastal aquifers (CNRA 2009). Water quality concerns may impact both drinking water supplies and instream flows for environmental uses. Water quality issues may also have impacts on wastewater treatment, the altered assimilative capacity of receiving waters may alter treatment standards, and collection systems may be inundated in flooding events. More prevalent wildfires may result in aerial deposition of pollutants into water bodies.

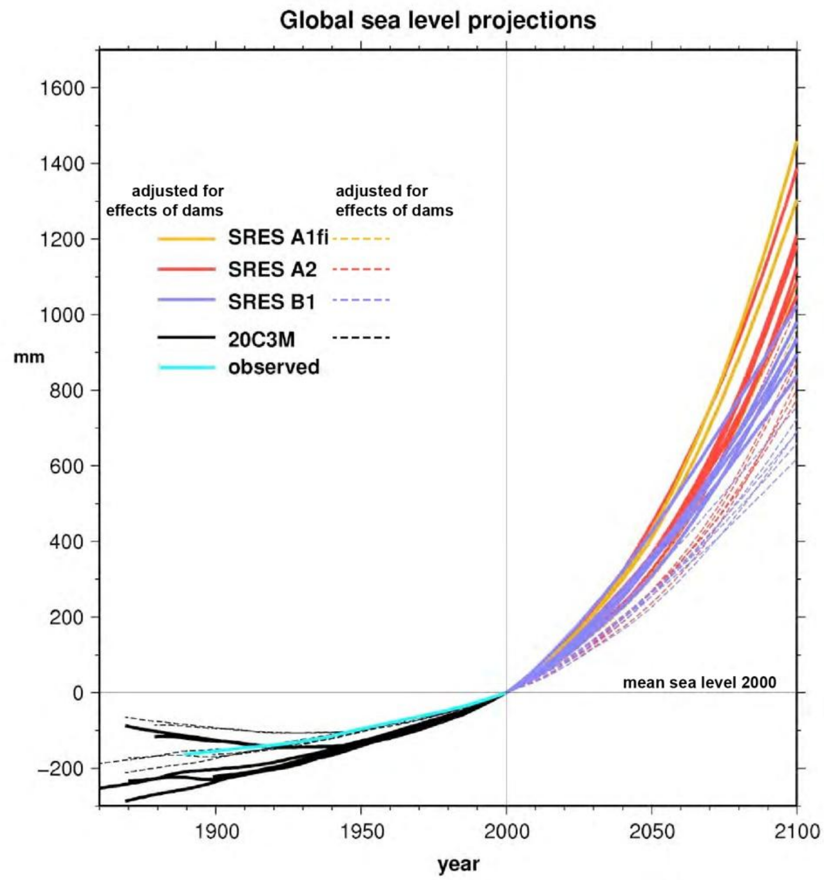

Figure 2-7: Projected Sea Level Rise from several GCM/emissions model results. (Source: Cayan et al 2009)

Sea Level Rise. There is little debate that sea levels will rise in the next century, but there are several approaches to estimating the extent of the rising. The Coastal and Ocean Working Group of the California Climate Action Team (CO-CAT) has developed guidance estimating that sea levels will rise between 10 and 17 inches by 2050, and between 31 and 69 inches by the end of the century (CO-CAT 2010), as shown in Figure 2-7. This projection has been adopted by the California Ocean Protection Council (OPC) in a resolution on sea level rise (OPC 2010). Rising sea levels threaten levees, especially in the Delta. Sea level rise increases the risk of storm surges and the flooding of coastal residences and infrastructure. Intruding salinity, due to sea level rise, may threaten water quality for some of California's water supplies in places like the Delta. Sea level rise and changes in precipitation patterns will also impact ecosystems in coastal areas that rely on a balance between freshwater and salt water, and may increase saline infiltration into coastal aquifers.

Flooding. In addition to increased coastal flooding resulting from sea level rise, severity of non-coastal flooding will also increase in the future. The current suite of climate models is not designed to project extreme precipitation events that cause flooding. However, there is some agreement among climate experts that the climatological conditions which drive extreme precipitation events will become more common, increasing the likelihood of extreme weather events. Rising snowlines will also increase the surface area in watersheds receiving precipitation as rain instead of snow (DWR 2008).

Ecological Effects. Habitats for temperature-sensitive fish may be impacted by increased water temperatures (DWR 2008). Surface water bodies will also be more susceptible to eutrophication with increased temperatures. Species susceptible to heat waves, droughts, and flooding may be in danger. Invasive species may become even more challenging to manage (CCSP 2009). Climate change will stress forested areas, making them more susceptible to pests, disease, and changes in species composition. With less frequent but more intense rainfall, wildfires are likely to become more frequent and intense, potentially resulting in changes in vegetative cover (CCSP 2009, SNA 2010). Coastal ecosystems that are sensitive to acidification and changes in salinity balances, sedimentation, and nutrient flows (such as estuaries and coastal wetlands) may be particularly vulnerable (CNRA 2009).

Hydropower Generation. Hydropower is a significant clean energy source in California: 21% of the state's electricity is generated from hydropower (CAT 2008). As spring snow-melt timing shifts, power generation operations may also need to shift to accommodate flood control (DWR 2008). Maximum power generation capacity may not coincide with maximum energy demands in the hot summer months. Several studies have projected various levels of hydropower losses. The California Climate Action Team projected that power generation will decrease by 6% by the end of the century for the State Water Project system, and by 10% for the Central Valley system (CAT 2009). Higher elevation hydropower generation units may see a decrease of as much as 20% of annual power generation (Medellin-Azuara et al 2009).

2.5 Summary

This section lays the foundation for most of the topics discussed in this handbook, including climate change mitigation, climate projections, climate change impacts analyses, and uncertainty involved in climate change science and future climate projections. Understanding the mechanisms of climate change helps planners assess and reduce a region's local contribution to future climate change. Local GHG emissions inventories are discussed in Section 3. Understanding currently observed and anticipated water resources impacts help regions identify and prioritize local vulnerabilities to climate change impacts, which is discussed further in section 4. The IPCC modeling suite is used, at least indirectly, as a basis for most future climate conditions assessments and impacts analyses (discussed in Section 5). Ways of incorporating uncertainty into both climate impacts analyses and into the planning process overall are discussed further in Appendix C and Section 7, respectively.

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